automax®

Vérin sans tige profil plat à accouplement magnétique WRV

Magnet Type

Flat Rodless Cylinders **WRV**

Environmentally friendly RoHS compliant product!

Unique oval barrel design enables good low-speed performance, low center of gravity, and non-rotating.

Basic Type

Low-Speed Performance
Superior low-speed performance of 8mm/s.
Best performance among Magnet Type Rodless cylinders.

Direct Mounting
A block-type end plate makes direct mounting possible.

Plate bumper (urethane rubber)

Side surface piping

Non-Rotating

Thin Design
Reduced by 30% in height

End surface piping

Side surface piping

With Shock Absorber Specification

Non-Rotating

Shock Absorber
A dedicated linear orifice shock absorber installed.
Absorbs impacts softly without any adjustment.

Adjustable Stroke
Simple stroke adjustment, just by moving the shock absorber.

Caution Before use, be sure to read the “Safety Precautions” on p. .

Product Range

Basic Type

With Shock Absorber Specification

Options

Sensor Switc

By installing a sensor rail and sensor magnet, positioning detection across the full stroke range is possible.

M-type Mount

Combines with linear guide to reduce the height to a minimum, and also offers various connection with equipment.

Standard Strokes

Model / Stroke (mm)	WRV14	WRV22	WRV28
100	●		
150	●		
200	●	●	●
250	●	●	●
300	●	●	●
350	●	●	●
400	●	●	●
450	●	●	●
500	●	●	●
600		●	●
700		●	●
800		●	●
Available stroke	1～1000	1～1500	1～1500

INDEX

Safety Precautions (Flat Rodless Cylinders)

Always read these precautions carefully before use.

Before selecting and using the products, please read all the Safety Precautions carefully to ensure proper product use.
The Safety Precautions shown below are to help you use the product safely and correctly, and to prevent injury or damage to you, other people, and assets beforehand.
Follow the Safety Precautions for: ISO4414 (Pneumatic fluid power—Recommendations for the application of equipment to transmission and control systems), JIS B 8370 (Pneumatic system regulations)

The directions are ranked according to degree of potential danger or damage:
"DANGER!", "WARNING!", "CAUTION!", and "ATTENTION!"

⚠ **DANGER**	Expresses situations that can be clearly predicted as dangerous. If the noted danger is not avoided, it could result in death or serious injury. It could also result in damage or destruction of assets.
⚠ **WARNING**	Expresses situations that, while not immediately dangerous, could become dangerous. If the noted danger is not avoided, it could result in death or serious injury. It could also result in damage or destruction of assets.
⚠ **CAUTION**	Expresses situations that, while not immediately dangerous, could become dangerous. If the noted danger is not avoided, it could result in light or semi-serious injury. It could also result in damage or destruction of assets.
⚠ **ATTENTION**	While there is little chance of injury, this content refers to points that should be observed for appropriate use of the product.

■This product was designed and manufactured as parts for use in General Industrial Machinery.

- In the selection and handling of the equipment, the system designer or other person with fully adequate knowledge and experience should always read the Safety Precautions, Catalog, User's Manual and other literature before commencing operation. Making mistakes in handling is dangerous.
- After reading the Instruction Manual, Catalog, etc., always place them where they can be easily available for reference to users of this product.
- If transferring or lending the product to another person, always attach the Instruction Manual, Catalog, etc., to the product where they are easily visible, to ensure that the new user can use the product safely and properly.
- The danger, warning, and caution items listed under these "Safety Precautions" do not cover all possible cases. Read the Catalog and User's Manual carefully, and always keep safety first.

⚠ DANGER

- Do not use the product for the purposes listed below:
  1. Medical equipment related to maintenance or management of human lives or bodies.
  2. Mechanical devices or equipment designed for the purpose of moving or transporting people.
  3. Critical safety components in mechanical devices.

  This product has not been planned or designed for purposes that require advanced stages of safety. It could cause injury to human life.
- Do not use the product in locations with or near dangerous substances such as flammable or ignitable substances. This product is not explosion-proof. It could ignite or burst into flames.
- When mounting the product and workpiece, always firmly support and secure them in place. When mounting the Flat Rodless cylinder, always mount it with an end plate tightened with mounting bolts at four counterbore locations (left and right).
  Failure to firmly secure the end plate could result in separation of the connection between the cylinder barrel and the end plate, leading to possible injury.
- Persons who use a pacemaker, etc., should keep a distance of at least one meter [3.28ft.] away from the product. There is a possibility that the pacemaker will malfunction due to the strong magnet built into the product.
- Never attempt to remodel the product. It could result in abnormal operation leading to injury, electric shocks, fire, etc.
- Never attempt inappropriate disassembly, assembly or repair of the product relating to basic construction, or to its performance or to functions. It could result in injury, electric shocks, fire, etc.
- Do not splash water on the product. Spraying it with water, washing it, or using it underwater could result in malfunction of the product leading to injury, electric shocks, fire, etc.
- While the product is in operation, avoid touching it with your hands or otherwise approaching too close. In addition, do not make any adjustments to the interior or to the attached mechanisms (sensor switch mounting location, disconnection of piping tubes or plugs, etc.).
  The actuator can move suddenly, possibly resulting in injury.
- When operating the product, always install speed controllers, and gradually loosen the needle valve from a choked state to adjust the speed increasing. Failure to make this adjustment could result in sudden movements, putting human lives at risk.

⚠ WARNING

- Do not use the product in excess of its specification range. Such use could result in product breakdowns, function stop or damage or drastically reduce the operating life.
- Before supplying air or electricity to the device and before starting operation, always conduct a safety check of the area of machine operation. Unintentional supply of air or electricity could possibly result in electric shocks, or in injury caused by contact with moving parts.
- Do not touch the terminals and the miscellaneous switches, etc., while the device is powered on. There is a possibility of electric shocks and abnormal operation.
- Do not allow the product to be thrown into fire. The product could explode and/or release toxic gases.
- Do not sit on the product, place your foot on it, or place other objects on it. Accidents such as falling and tripping over could result in injury. Dropping the product may result in injury, or also damage or break the product resulting in abnormal or erratic operation, or runaway, etc.
- When conducting any kind of operation for the product, such as maintenance, inspection, repair, or replacement, always turn off the air supply completely and confirm that residual pressure inside the product or in piping connected to the product is zero before proceeding. In particular, be aware that residual air will still be in the air compressor or air storage tank. The actuator could abruptly move if residual air pressure remains inside the piping, causing injury.
- Do not use the actuator for equipment whose purpose is absorbing the shocks and vibrations of mechanical devices. It could break and possibly result in injury or in damage to mechanical devices.

- Avoid scratching the cords for the sensor switch lead wires, etc. Letting the cords be subject to scratching, excessive bending, pulling, rolling up, or being placed under heavy objects or squeezed between two objects, may result in current leaks or defective continuity that lead to fires, electric shocks, or abnormal operation.
- Do not subject sensor switches to an external magnetic field during actuator operation. Unintended movements could result in damage to the equipment or in personal injury.
- Use within the recommended load and operating frequency specifications. Attempting to use beyond the recommended load and operating frequency specifications could damage the table, etc., which could result in damage to the equipment or personal injury. It could also drastically reduce the product's operating life.
- Use safety circuits or create system designs that prevent damage to machinery or injury to personnel when the machine is shut down due to an emergency stop or electrical power failure.
- Install relief valves, etc., to ensure that the actuator does not exceed its rated pressure when such pressure is rising due to external forces on the actuator. Excessive pressure could lead to a breakdown and damage.
- In initial operations after the equipment has been idle for 48 hours or more, or has been in storage, there is a possibility that contacting parts may have become stuck, resulting in equipment operation delays or in sudden movements. Before these initial operations, always run a test to check that operating performance is normal.

⚠ CAUTION

- Do not use in locations that are subject to direct sunlight (ultraviolet rays), dust, salt, iron powder, humidity, or in the media and/or the ambient atmospheres that include organic solvents, phosphate ester type hydraulic oil, sulphur dioxide, chlorine gas, acids, etc. It could lead to early shutdown of function or a sudden degradation of performance, and result in a reduced operating life. For the materials, see the Major Parts and Materials.
- When mounting the product, leave room for adequate working space around it. Failure to ensure adequate working space will make it more difficult to conduct daily inspections or maintenance, which could eventually lead to system shutdown or damage to the product.
- Do not bring floppy disks or magnetic media, etc., within one meter [3.28ft.] of the product. There is the possibility that the data on the floppy disks will be destroyed due to the magnetism of the magnet.
- Do not use the sensor switch in locations subject to large electrical currents or strong magnetic fields. It could result in erratic operation. In addition, do not use magnetized materials in the mounting bracket. The magnetism could leak, possibly resulting in erratic operation.
- Do not bring the product too close to a magnetic body. Positioning it near a magnetic body or strong magnetic field will cause erratic operation of sensor switches due to magnetization of the main body and table, or cause failure by adherence of iron powder, etc.
- Never use other companies' sensor switches with these products. It could possibly cause error or accidental operation.
- Do not scratch, dent, or deform the actuator by climbing on the product, using it as scaffold, or placing objects on top of it. It could lead to damaged or broken products that result in operation shutdown or degraded performance.
- Always post an "operations in progress" sign for installations, adjustments, or other operations, to avoid unintentional supplying of air or electrical power, etc. Such accidental supplies may cause electrical shocks, or sudden activation of the actuator that could result in physical injury.
- Do not pull on the cords of the lead wires, etc., of the sensor switches mounted on the actuators, grab them to lift, or place heavy objects or excessive loads on them. Such action could result in current leaks or defective continuity that lead to fire, electric shocks, or abnormal operation.

⚠ ATTENTION

- When considering the possibility of using this product in situations or environments not specifically noted in the Catalog or User's Manual, or in applications where safety is an important requirement such as in an airplane facility, combustion equipment, leisure equipment, safety equipment and other places where human life or assets may be greatly affected, take adequate safety precautions such as the application with enough margins for ratings and performance or fail-safe measure. Be sure to consult us with such applications.
- Always check the Catalog and other reference materials for product wiring and piping.
- Use a protective cover, etc., to ensure that the operating parts of mechanical devices, etc., are isolated and do not come into direct contact with human bodies.
- Do not control in a way that would cause workpieces to fall during a power failure. Take control measures so that they prevent the table or workpieces, etc., from falling during a power failure or emergency stop of the mechanical devices.
- When handling the product, wear protective gloves, safety glasses, safety boots, etc., to keep safety.
- When the product can no longer be used, or is no longer necessary, dispose of it appropriately as industrial waste.
- Pneumatic equipment can exhibit degraded performance and function over its operating life. Always conduct daily inspections of the pneumatic equipment, and confirm that all requisite system functions are satisfied, to prevent accidents from happening.
- For inquiries about the product, consult your nearest Automax sales office or Automax overseas department. The address and telephone number is shown on the back cover of this catalog.

⚠ OTHERS

- Always observe the following items.
  1. When using this product in pneumatic systems, always use genuine Automax parts or compatible parts (recommended parts).
     When conducting maintenance and repairs, always use genuine Automax parts or compatible parts (recommended parts). Always observe the required methods and procedure.
  2. Never attempt inappropriate disassembly or assembly of the product relating to basic configurations, or its performance or functions.

Automax cannot be responsible if these items are not properly observed.

Design and selection

⚠ Warning

1. Check the specifications.
As use of this product over the specified ranges of voltage, current, temperature, shocks, etc., could result in a breakdown or abnormal operation, always read the specifications carefully to ensure correct use.

2. Avoid mounting actuators in close proximity.
Mounting two or more actuators with sensor switches in close proximity could result in erratic operation of the sensor switches, due to magnetic field interference with the system.

3. Caution about sensor switch ON time for positioning detection at intermediate stroke position.
Take caution that if the sensor switch is mounted at an intermediate position of the actuator stroke for detection of the piston travel, the sensor switch actuation time may be too short when the actuator speed is very rapid, so that the load (sequencer, etc.) may fail to activate.
Maximum cylinder speed for positioning detection

$$V\ (mm/s)\ [in./sec.] = \frac{\text{Sensor switch actuation range (mm) [in.]}}{\text{Time required for activating load (ms)}} \times 1000$$

4. Keep wiring as short as possible.
The solid state sensor switch lead wire length should be within 30m [98ft.] as stipulated in the EN standards. For the reed sensor switch, if the lead wire is too long (10m [33ft.] or more), capacitive surges will shorten the operating life of the sensor switch. If long wiring is needed, install the protection circuit mentioned in the catalog. If the load is inductive or capacitive, also install the protection circuit mentioned in the catalog.

5. Avoid repeated or excessive bending or pulling of lead wires.
Applying repeated bending stress or tension force on the lead wire could result in wire breakage.

6. Check for leakage current.
2-lead wire solid state sensor switches produce leakage current to activate their internal circuits, and the current passes through a load even when in the turned-off condition. Ensure they satisfy the following inequality.

Input off current of programmable controller > Leakage current

If the above inequality cannot be satisfied, select a 3-lead wire solid state sensor switch, instead. Also note that parallel connection of a total of n sensor switches will multiply the amount of leakage current by n times.

⚠ Caution

1. Check for sensor switch internal voltage drop.
Series connection of reed sensor switches with indicator lamps or 2-lead wire solid state sensor switches causes increasing internal voltage drop, and the load may fail to activate. A total of n sensor switches will lead to n times the internal voltage drop. Ensure that the system satisfies the following inequality.

Supply voltage – Internal voltage drop × n > Minimum operating voltage for load

In relays with rated voltage of less than DC24V, check to see whether the above inequality is satisfied, even in the case of n = 1. If the above inequality cannot be satisfied, select a reed sensor switch without indicator lamp.

2. Do not use our sensor switches with other companies' actuators.
The sensor switches are designed for use with Automax actuators only. Use with other companies' actuators could lead to abnormal operation.

Installation and adjustment

⚠ Warning

1. Do not apply an external magnetic field to the sensor switch while the actuator is in operation.
An unintended movement could result in damage to the equipment or in personal injury.

⚠ Caution

1. Ensure a safe installation environment for the actuators with sensor switches.
Do not use sensor switches in places where large current or magnetic fields are present. This could lead to unintentional operation. Do not use magnetic material for the mounting brackets. It could result in erratic operation.

2. Install sensor switches in the center of their operating range.
Adjust the mounting position of a sensor switch so that the piston stops in the center of its operating range (the range while the sensor turns ON). Operations will be unstable if mounted at the end of the operating range (at the boundary near ON and OFF). Also be aware that the operating range will vary with changes in temperature.

3. Follow the tightening torque of sensor switches when mounting.
Over-tightening beyond the allowed tightening torque may damage the mounting threads, mounting brackets, sensor switches, etc. In addition, insufficient tightening torque could cause the sensor switch position to be changed, resulting in operation instability. For the tightening torque, follow the instructions on p.! 9

4. Do not carry the actuator grabbing its sensor switch lead wires.
After mounting a sensor switch to an actuator, do not grab and lift the lead wires to carry the actuator. Never do this, as it could result in lead wire disconnections, and could also apply stress to the interior of the sensor switch, resulting in breakage of internal elements.

5. Do not drop sensor switches, or bump them against others.
During handling of sensor switches, do not apply excessive shocks (294.2m/s^2 [965ft./sec.^{2}] {30G} or larger) such as hitting, dropping, or bumping. In reed sensor switches, the contact reed may be activated unintentionally, causing it to send or break sudden signals. It may also cause changes in the contact interval that lead to changes in sensor switch sensitivity and result in erratic operation. Even if the sensor switch case is undamaged, the inner parts of the sensor switch may suffer breakdown or cause erratic operation.

Wiring

⚠ Danger

1. Avoid letting moving objects near sensor switches come into contact with them.
When the actuators with sensor switches are moving, or when moving objects are nearby, do not let them come into contact each other. In particular, lead wires could become worn out or damaged, causing operating instability in the sensor switch. In the worst case, it could result in current leaks or electrical shocks.

2. Always turn off the power supply for wiring work.
Conducting wiring work while the power is on could result in electric shocks. Also, incorrect wiring could damage sensor switches in an instant. Turn on the power only after the wiring work is completed.

⚠ Warning

1. Check the Catalog, etc., to ensure that the sensor switch wiring is correctly connected.
Miswiring could result in abnormal operation.

2. Do not share the same wiring with power or high voltage lines.
Avoid wiring in parallel to or shared with power or high voltage lines. The sensor switch or control circuit may suffer electric noise that results in erratic operation.

3. Avoid repeated or excessive bending or pulling of lead wires.
Applying repeated bending stress or tension force on the lead wire could result in wire breakage.

4. Check polarity in the wiring.
In sensor switches that specify polarity (+, –, output), be sure that wiring connections are correct. The wrong polarity could result in damage to sensor switches.

⚠ Caution

1. Avoid short circuiting the loads.
Turning a sensor switch on while the load is short-circuited causes overcurrent, which will damage the sensor switch in an instant.
Example of short-circuited load: Sensor switch's output lead wire is directly connected to the power supply.

General precautions

Media

1. Use air for the media. For the use of any other media, consult us.

2. Air used for the Flat Rodless cylinders should be clean air that contains no deteriorated compressor oil, etc. Install an air filter (filtration of 40 μm or less) near the Flat Rodless cylinders or valve to remove collected liquid or dust. In addition, drain the air filter periodically. Collected liquid or dust entering the Flat Rodless cylinder may cause improper operation.

Piping

1. In piping connection with the Flat Rodless cylinders, flush the tube completely (by blowing compressed air) before piping. Intrusion of machining chips, sealing tape, rust, etc., generated during plumbing could result in air leaks and other defective operations.

2. When screwing in piping or fittings to the Flat Rodless cylinders, tighten to the appropriate tightening torque shown below.

Connecting thread	Tightening torque N·m {kgf·m} [ft·lbf]
M5× 0.8	1.6 {0.16} [1.2]
Rc1/8	6.9～8.8 {0.69～0.88} [5.1～6.5]

Atmosphere

1. When using in locations subject to dripping water, dripping oil, etc., or to large amounts of dust, use a cover to protect the unit.

2. The product cannot be used when the media or ambient atmosphere contains any of the substances listed below.
Organic solvents, phosphate ester type hydraulic oil, sulphur dioxide, chlorine gas, or acids, etc.

Lubrication

The Flat Rodless cylinders can be used without lubrication. If lubrication is required, however, always consult us first. Do not use turbine oil.

Others

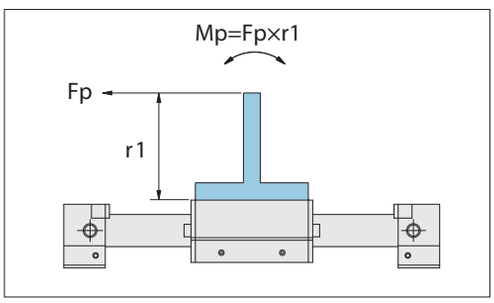
1. When the Flat Rodless cylinder is moved manually, its movement may not feel smooth. This is not a problem, however, since it is normally operated using air pressure. Always apply air to the system to check its operation.

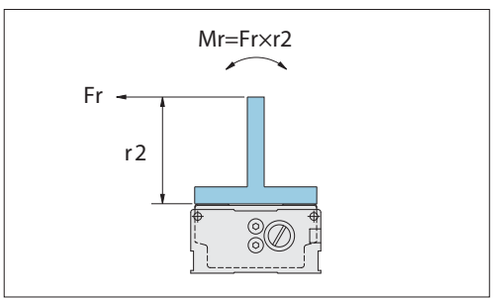
2. The Flat Rodless cylinder has a strong magnet integrated into its body. Do not place magnetic media, recording devices, magnetic detection devices, etc., within 1 meter [3.28ft.] of the product. This could result in lost data or erratic operation.

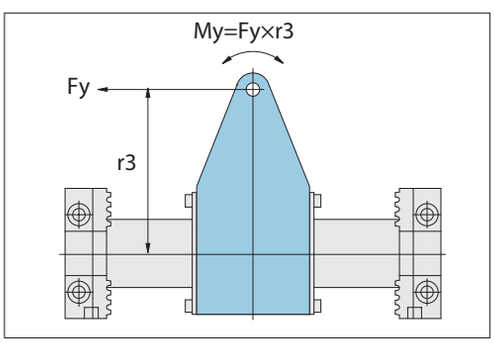
Selection

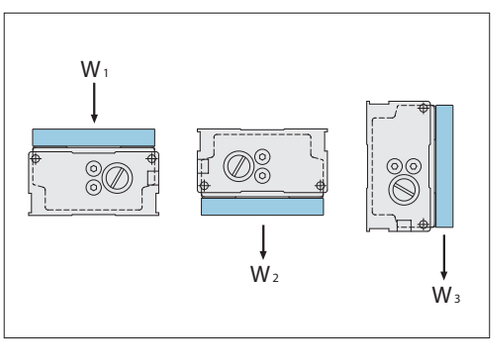
Allowable load and moment

Although the Flat Rodless cylinders can be used with directly applying loads, make sure that the load and moment do not exceed the values in the table below. In addition, since load capacity may vary depending on the speed, confirm the rubber bumper and shock absorber absorption capacity on p. before use.









Pitching moment : Mp＝Fp× r1(N·m)
Rolling moment : Mr＝Fr× r2 (N·m)
Yawing moment : My＝Fy× r3 (N·m)
Maximum load capacity : W_1,W_2,W_3 (N)

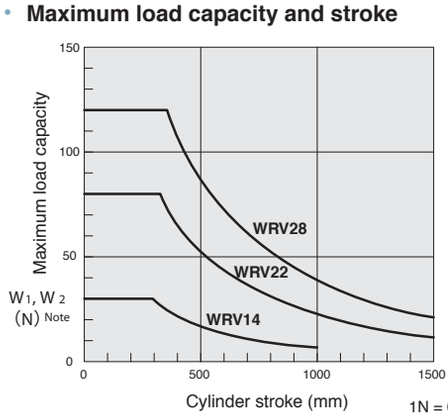
Note: External forces Fp and Fy should be restricted to 60% or less of the magnet retaining force.

Model \ Direction of moment	Mp N·m {kgf·m} [ft·lbf]	Mr N·m {kgf·m} [ft·lbf]	My N·m {kgf·m} [ft·lbf]	W_1 Note N {kgf} [lbf.]	W_2 Note N {kgf} [lbf.]	W_3 Note N {kgf} [lbf.]
WRV14	1.2 {0.1} [0.9]	0.3 {0.03} [0.2]	1.2 {0.1} [0.9]	30 {3} [6.7]	30 {3} [6.7]	10 {1} [2.2]
WRV22	4 {0.4} [3.0]	1 {0.1} [0.7]	4 {0.4} [3.0]	80 {8} [18.0]	80 {8} [18.0]	30 {3} [6.7]
WRV28	8 {0.8} [5.9]	2 {0.2} [1.5]	8 {0.8} [5.9]	120 {12} [27.0]	120 {12} [27.0]	45 {4.5} [10.1]

Caution: The moment including the inertial force generated when the load is moved or stopped must not exceed the values in the above table.
Keep the mass and speed within the range of the rubber bumper and shock absorber capacity graphs.

Note: W is the maximum value. Since W varies depending on the stroke, use it within the "Maximum load capacity and stroke" ranges shown in the graph below.

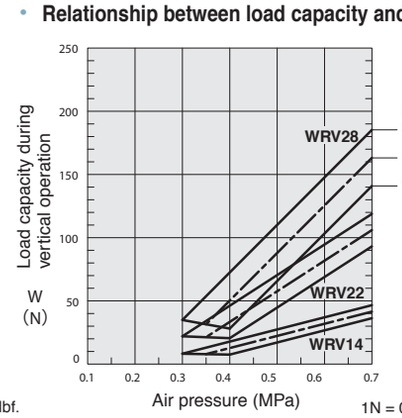
- **Maximum load capacity and stroke**

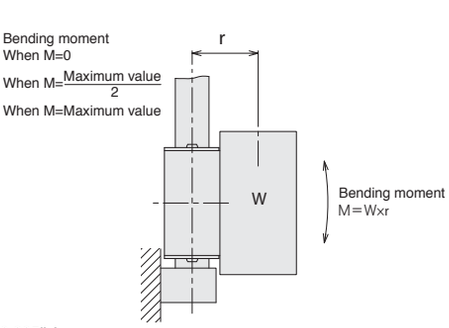


Note: The value for W_3 is 1/3 that of W_1 and W_2.

1N = 0.225lbf.
1mm= 0.0394in.

- **Relationship between load capacity and air pressure during vertical operation (reference)**

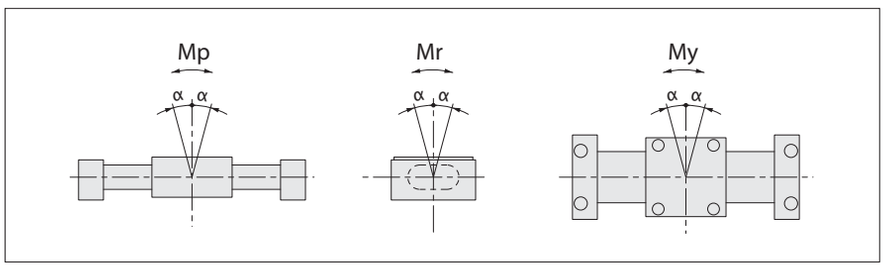




1N = 0.225lbf.
1MPa= 145psi.

Slider deflection

The reference values of the amount of slider deflection due to clearance is shown in the table below. Since the slider portion of the Flat Rodless cylinder allows a certain amount of play as shown below, use the cylinder with a linear guide in high-precision applications.



Model	Slider deflection? (±α°)		
	Mp direction	Mr direction	My direction
WRV14	0.8	1.8	0.8
WRV22	0.6	1.2	0.6
WRV28	0.7	1.3	0.7

Cushioning capacity

- **Rubber bumper capacity**

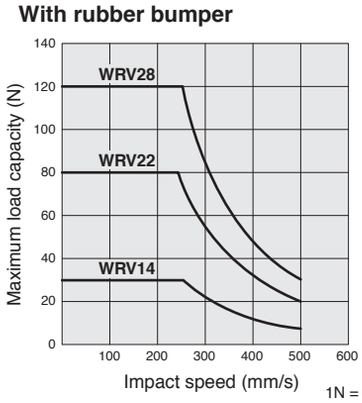
The Flat Rodless cylinders come with rubber bumpers as standard equipment. The maximum load capacity and impact speed, however, should lie within the “With rubber bumper” range shown in the “Rubber bumper and shock absorber capacity graph” below. Do not use it when the maximum impact speed exceeds 500mm/s [19.7in./sec.].

- **Shock absorber absorption capacity**

The Flat Rodless cylinders use shock absorbers as optional equipment. The maximum load capacity and impact speed, however, should lie within the “With shock absorber” range shown in the “Rubber bumper and shock absorber capacity graph” below. Do not use it when the maximum impact speed exceeds 800mm/s [31.5in./sec.].

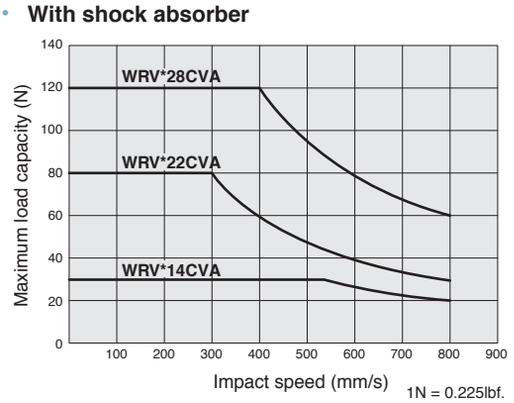
- **Rubber bumper and shock absorber capacity graph**
  (Horizontal operation, at air pressure of 0.5MPa [73psi.])

- **With rubber bumper**



1N = 0.225lbf.
1mm/s= 0.0394in./sec.

- **With shock absorber**

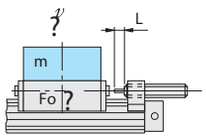
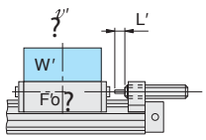


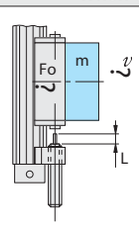
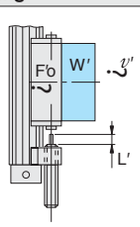
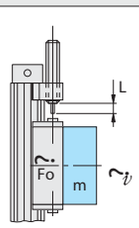
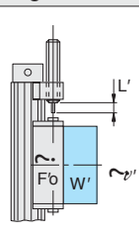
1N = 0.225lbf.
1mm/s= 0.0394in./sec.

In the graphs, “Impact speed” refers to the speed immediately before the slider impacts the rubber bumper or shock absorber. This is not the same as “average speed (cylinder stroke/travel time)”.

Handling Instructions and Precautions

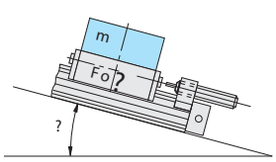
Calculation of impact energy

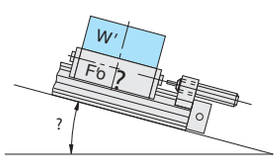
Horizontal impact	
	
$E=E_1+E_2$ $=\frac{m\cdot V^2}{2}+F_0\cdot L$	$E'=E'_1+E'_2$ $=\frac{W'\cdot V^2}{2g'}+F'_0\cdot L'$

Vertical impact Note 1			
When descending Note 2		When ascending	
			
$E=E_1+E_2+E_3$ $=\frac{m\cdot V^2}{2}+F_0\cdot L+m\cdot g\cdot L$	$E'=E'_1+E'_2+E'_3$ $=\frac{W'\cdot V^2}{2g'}+P'_0\cdot L'+W'\cdot L'$	$E=E_1+E_2-E_3$ $=\frac{m\cdot V^2}{2}+F_0\cdot L-m\cdot g\cdot L$	$E'=E'_1+E'_2-E'_3$ $=\frac{W'\cdot V^2}{2g'}+P'_0\cdot L-W'\cdot L'$

Note 1: For impact on incline,
E_3 becomes $E_3 = m\cdot g\cdot L\cdot\sin\theta$.

Note 1: For impact on incline,
E'_3 becomes $E'_3 = W'\cdot L'\cdot\sin\theta$.





Note 2: When descending, heavier loads can be carried using lower operating air pressure (P) than when ascending.

E : Total impact energy … [J]

E_1 : Kinetic energy … $\frac{m\cdot V^2}{2}$ [J]

E_2 : Additional energy by cylinder thrust …Fo·L [J]

E_3 : Additional energy by load mass …m·g·L [J]

m : Load mass [kg]

V : Impact speed [m/s]

g : Gravity acceleration 9.8 [m/s²]

Fo : Cylinder thrust … $=\frac{\pi}{4}\cdot D^2\cdot P$ [N]

[D: Cylinder bore (mm) P: Operating air pressure (MPa)]

L : Absorbing stroke of shock absorber [m]

Note 2: When descending, heavier loads can be carried using lower operating air pressure (P′) than when ascending.

E′ : Total impact energy … [ft·lbf]

E'_1 : Kinetic energy … $\frac{W'\cdot V^2}{2g'}$ [ft·lbf]

E'_2 : Additional energy by cylinder thrust …Fo·L′ [ft·lbf]

E'_3 : Additional energy by load weight …W′·L′ [ft·lbf]

W′ : Load weight [lbf]

V′ : Impact speed [ft./sec.]

g′ : Gravity acceleration 32.2 [ft./sec.]

Fo : Cylinder thrust … $=\frac{\pi}{4}\cdot D'^2\cdot P'$ [lbf.]

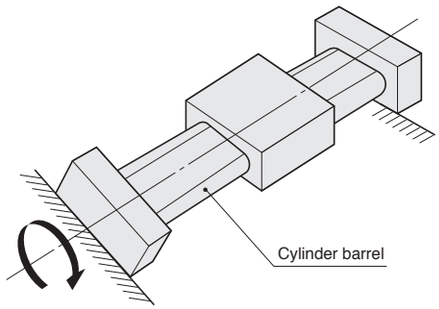
[D′ : Cylinder bore [in.] P′ : Operating air pressure [psi.]]

L′ : Absorbing stroke of shock absorber [ft.]

Mounting

Mounting

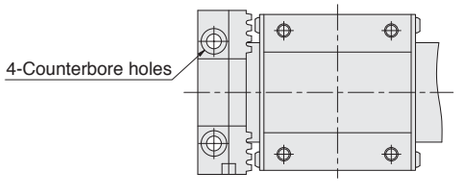
1. Because the Flat Rodless cylinders have strong magnets built into the cylinder bodies, they cannot be used in locations with magnetized cutting oil or powder.
2. Be careful to avoid making scratches, dents, etc., on the cylinder barrel.
3. If an external force larger than the magnetic retaining force is applied, causing the slider and piston to deviate or completely separate, return the piston to the stroke end and then apply external force to the slider to restore it to the correct position.
4. When using in locations where the cylinder can easily become smeared, clean the cylinder periodically.
   After cleaning, always apply grease to the surface of the cylinder barrel. For the type of grease to be applied, consult us.
5. Mount the cylinder barrel so that it cannot be twisted. Insufficient flatness of the mounting surface could result in cylinder barrel twisting and malfunctions.



6. When mounting the body, always secure it by mounting bolts at 4 counterbore holes on the end plate (left and right).

Tightening torque N·m {kgf·cm} [ft·lbf]

Model	WRV14	WRV22	WRV28
Tightening torque	2.8 {28} [2.1] (M4)	6 {60} [4.4] (M5)	10 {100} [7.4] (M6)



Mounting the shock absorber

Tightening torque for shock absorber hexagon nuts N·m {kgf·cm} [ft·lbf]

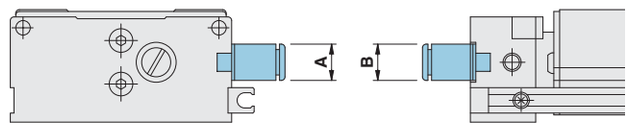
Model	For **WRV14** KSHJM8×5-14	For **WRV22** KSHJM8×5-22	For **WRV28** KSHJM10×10-28
Tightening torque	2.5 {25} [1.8]		6.5 {65} [4.8]

1. Use the shock absorber within its absorption capacity range (from its capacity graph).
2. The maximum impact speed to the shock absorber is 800mm/s [31.5 in./sec.]. Note that this is not the same as the average speed. The speed at time of impact should not exceed 800mm/s [31.5 in./sec.].
3. Do not use the shock absorber in a place subject to large amounts of dripping water, dripping oil, or dust. If using it in these places, install a cover, etc., so that the liquid drops etc. do not drip on it directly. This could lead to improper operation and might decrease the absorption energy.
4. Do not loosen the set screw on the center of the shock absorber's back end surface. The oil sealed inside will leak out, which will cause the shock absorber to fail.
5. Do not install other shock absorbers in this product. Because product characteristics vary among shock absorbers, if other shock absorbers are used, damage to the cylinder, etc., may occur.

Size of piping materials

For the side surface port with a sensor rail type, the distance to the sensor rail determines the outer diameter of the attached piping fitting, while for an end surface port, the diameter of the counterbore determines the outer diameter. For the outer diameters of piping fittings, use the below table.

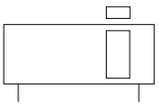
Model	Side surface (with sensor rail)	End surface
	A	**B**
WRV14	Ø 10 [0.394in.]	Ø 10 [0.394in.]
WRV22	Ø 13 [0.512in.]	Ø 10 [0.394in.]
WRV28	Ø 16 [0.630in.]	- -



FLAT RODLESS CYLINDERS WRV

Specification

Symbol



Specifications

Item \ Model		WRV14	WRV22	WRV28
Equivalent bore size mm [in.]		14 [0.551]	22 [0.866]	28 [1.102]
Media		Air Note1		
Operating type		Double acting type		
Operating pressure range MPa {kgf/cm²} [psi.]		0.2～0.7 {2～7.1} [29～102]		
Proof pressure MPa {kgf/cm²} [psi.]		1.05 {10.7} [152]		
Operating temperature range °C [°F]		0～60 [32～140]		
Operating speed range mm/s [in./sec.]	Basic type	8～500 [0.31～19.7] Note2		
	With shock absorber specification	8～800 [0.31～31.5] Note2		
Cushion	Basic type	Rubber bumper		
	With shock absorber specification	Shock absorber		
Lubrication		Not required Note3		
Stroke adjusting range (with shock absorber specification only) (per one side in specification stroke) mm [in.]		0～−10 [0～−0.394]	0～−6 [0～−0.236]	0～−15 [0～−0.591]
Maximum stroke mm		1000	1500 Note4	
Stroke tolerance mm [in.]		$+2\ [+0.079]$ $0\ [0]$		
Port size		M5×0.8		Rc1/8

Notes: 1. Use clean air that contains no moisture, dust, and oxidized oil.
2. For the relationship between the maximum load capacity and the impact speed, see the “Rubber bumper and shock absorber capacity graph” on p. .
3. This product can be used without lubrication. If lubrication is required, however, always consult us. Do not use turbine oil.
4. The maximum stroke of the cylinder with sensor rail is 1000mm.

Magnet Retaining Force

N {kgf} [lbf.]

Item \ Model	WRV14	WRV22	WRV28
Retaining force	115 {11.7} [25.9]	310 {31.6} [69.7]	500 {51} [112]

Specifications of Shock Absorber

Item \ Model	WRV*14CVA	WRV*22CVA	WRV*28CVA
Applicable shock absorber	KSHJM 8× 5-14	KSHJM 8× 5-22	KSHJM 10× 10-28
Maximum absorption J {kgf·m} [ft·lbf]	1 {0.1} [0.7]	1.5 {0.15} [1.1]	3 {0.3} [2.2]
Absorbing stroke mm [in.]	5 [0.197]		10 [0.394]
Maximum impact speed mm/s [in./sec.]	800 [31.5]		
Maximum operating frequency cycle/min	60		
Spring return force (compressed) N {kgf} [lbf.]	6 {0.6} [1.3]		8 {0.8} [1.8]
Angle variation	1° or less		
Operating temperature range °C [°F]	0～60 [32～140]		

Note: The life of the shock absorber may vary from the Flat Rodless cylinder, depending on its operating condition.

Equivalent Bore Size and Stroke

mm

Model \ Item	Standard strokes	Maximum available stroke	Maximum available stroke with sensor rail
WRV(*)14CV*	100, 150, 200, 250, 300, 350, 400, 450, 500	1～1000	1～1000
WRV(*)22CV*	200, 250, 300, 350, 400, 450, 500, 600, 700, 800	1～1500	
WRV(*)28CV*	200, 250, 300, 350, 400, 450, 500, 600, 700, 800	1～1500	

Remark: Non-standard strokes are available at 1mm intervals.

Mass

kg [oz.]

Model		Zero stroke mass	Additional mass for each 1mm [0.0394in.] stroke	Shock absorber unit		M-type mount	Sensor magnet	Zero stroke mass of sensor rail	Additional mass for each 1 mm [0.0394in.] sensor rail	Sensor switch
				One side	Both sides					Lead wire 3m [118in.]
WRV(*)14CV	Basic type: **K**	0.22 [7.76]	0.000267 [0.00942]	-	-	0.017 [0.60]	0.004 [0.14]	0.007 [0.25]	0.0001 [0.0035]	0.035 [1.23]
	With shock absorber:**A**	0.27 [9.52]		0.01 [0.35]	0.02 [0.71]	-				
WRV(*)22CV	Basic type: **K**	0.50 [17.64]	0.000491 [0.01732]	-	-	0.03 [1.06]		0.008 [0.28]		
	With shock absorber:**A**	0.59 [20.81]		0.01 [0.35]	0.02 [0.71]	-				
WRV(*)28CV	Basic type: **K**	0.86 [30.34]	0.000656 [0.02314]	-	-	0.052 [1.83]		0.010 [0.35]		
	With shock absorber:**A**	1.00 [35.27]		0.022 [0.78]	0.044 [1.55]	-				

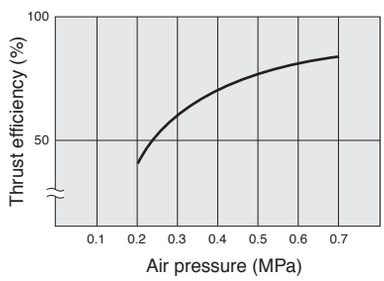
Theoretical Thrust

N [lbf.]

Model	Pressure area mm² [in.²]	Air pressure MPa					
		0.2 [29]	0.3 [44]	0.4 [58]	0.5 [73]	0.6 [87]	0.7 [102]
WRV14	157 [0.243]	31 [7.0]	47 [10.6]	63 [14.2]	79 [17.8]	94 [21.1]	110 [24.7]
WRV22	402 [0.623]	80 [18.0]	121 [27.2]	161 [36.2]	201 [45.2]	241 [54.2]	281 [63.2]
WRV28	628 [0.973]	126 [28.3]	188 [42.3]	251 [56.4]	314 [70.6]	377 [84.7]	440 [98.9]

The figures in the table are theoretical values. There may be some difference from these for practical applications.
For actual selection, see the thrust efficiency at left.
Note that thrust efficiency tends to be lower at low pressure.

Thrust efficiency



1MPa = 145psi.

Air Flow Rate and Air Consumption

While the Flat Rodless cylinder's air flow rate and air consumption can be found through the following calculations, the quick reference table below provides the answers more conveniently.

Air flow rate: $Q_1 = \frac{\pi D^2}{4} \times L \times \frac{60}{t} \times \frac{P+0.101}{0.101} \times 10^{-6}$

Air consumption: $Q_2 = \frac{\pi D^2}{4} \times L \times 2 \times n \times \frac{P+0.101}{0.101} \times 10^{-6}$

Q_1	: Required air flow rate for cylinder	R /min (ANR)
Q_2	: Air consumption of cylinder	R /min (ANR)
D	: Cylinder equivalent bore size	mm
L	: Cylinder stroke	mm
t	: Time required for cylinder to travel 1 stroke	s
n	: Number of cylinder reciprocations per minute	times/min
P	: Pressure	MPa

Air flow rate: $Q_1' = \frac{\pi D'^2}{4} \times L' \times \frac{60}{t} \times \frac{P'+14.70}{14.70} \times \frac{1}{1728}$

Air consumption: $Q_2' = \frac{\pi D'^2}{4} \times L' \times 2 \times n \times \frac{P'+14.70}{14.70} \times \frac{1}{1728}$

Q_1'	: Required air flow rate for cylinder	ft³/min. (ANR)
Q_2'	: Air consumption of cylinder	ft³/min. (ANR)
D'	: Cylinder equivalent bore size	in.
L'	: Cylinder stroke	in.
t	: Time required for cylinder to travel 1 stroke	sec.
n	: Number of cylinder reciprocations per minute	times/min
P'	: Pressure	psi.

Air consumption for each 1 mm [0.0394in.] stroke

cm³ [ft³]/Reciprocation (ANR)

Equivalent bore size mm [in.]	Air pressure MPa [psi.]					
	0.2 [29]	0.3 [44]	0.4 [58]	0.5 [73]	0.6 [87]	0.7 [102]
14 [0.551]	0.936 [3.31 × 10⁻⁵]	1.246 [4.40 × 10⁻⁵]	1.558 [5.50 × 10⁻⁵]	1.868 [6.60 × 10⁻⁵]	2.180 [7.70 × 10⁻⁵]	2.490 [8.79 × 10⁻⁵]
22 [0.866]	2.396 [8.46 × 10⁻⁵]	3.192 [1.127× 10⁻⁴]	3.988 [1.408× 10⁻⁴]	4.784 [1.689× 10⁻⁴]	5.580 [1.971× 10⁻⁴]	6.378 [2.252× 10⁻⁴]
28 [1.102]	3.744 [1.322× 10⁻⁴]	4.988 [1.761× 10⁻⁴]	6.232 [2.20 × 10⁻⁴]	7.476 [2.640× 10⁻⁴]	8.720 [3.079× 10⁻⁴]	9.966 [3.519× 10⁻⁴]

The figures in the table are for computing the air flow rate and air consumption when a Flat Rodless cylinder makes 1 reciprocation with stroke of 1mm [0.0394in.]. The air flow rate and air consumption actually required are found by the following calculations.

- Finding the air flow rate (for selecting F.R.L., valves, etc.)
  Example: When operating a Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] at a speed of 300mm/s [11.8in./sec.] under air pressure of 0.5MPa [73psi.]
  $4.784 \times \frac{1}{2} \times 300 \times 10^{-3} = 0.71$R/s [0.025ft³/sec.] (ANR)
  (At this time, the flow rate per minute is $4.784 \times \frac{1}{2} \times 300 \times 60 \times 10^{-3} = 43.05$R/min [1.52ft³/min.] (ANR))

- Finding the air consumption
  Example 1. When operating a Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] and a stroke of 100mm [3.94in.] under air pressure of 0.5MPa [73psi.], for 1 reciprocation
  $4.784 \times 100 \times 10^{-3} = 0.478$R [0.0169ft³]/Reciprocation (ANR)
  Example 2. When operating a Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] and a stroke of 100mm [3.94in.] under air pressure of 0.5MPa [73psi.], for 10 reciprocations per minute
  $4.784 \times 100 \times 10 \times 10^{-3} = 4.78$R/min [0.169ft³/min.] (ANR)

Note: To find the actual air consumption required when using the Flat Rodless cylinder, add the air consumption of the piping to the air consumption obtained from the above calculation.

Order Codes

- **Basic type**

WRV [P] [14] **CV** [K] [200]

Stroke

Cushion type
K : With rubber bumper
A : With shock absorber

Equivalent bore size

Magnet type
P : Without sensor rail & magnet
M : With sensor rail (Including sensor magnet)

Flat Rodless cylinder with rubber bumper Note

Note: *An M-type mount cannot be installed on a cylinder with shock absorber specification.*

- **Sensor switch specification**

Note: *To order separately*

XEZE1 [D] **-** [M8]

Lead wire termination
Blank : Without connector (length wire: 3000mm [118in.])
M8: With M8 connector (length wire: 300mm [11.8in.])

Lead wire orientation
D : Right output
L : Bent output (with angle 90°)

Sensor switch type
XEZE1D: 2-lead wire solid state type with indicator lamp DC10～28V
XEZE1L: 2-lead wire bent output solid state type with indicator lamp DC10～28V
XEZ31D: 3-lead wire solid state type with indicator lamp DC4.5～28V
XEZ31L: 3-lead wire bent outputsolid state type with indicator lamp DC4.5～28V
XRZE0D: 2-lead wire reed switch type without indicator lamp DC5～28V, AC85～115V
XRZE0L: 2-lead wire bent output reed switch type without indicator lamp DC5～28V, AC85～115V
XRZE1D: 2-lead wire reed switch type with indicator lamp DC10～28V, AC85～115V
XRZE1L: 2-lead wire bent output reed switch type with indicator lamp DC10～28V, AC85～115V

Additional Parts

- **M-type mount**

M-WRV [ ]

Equivalent bore size
14 : For **WRV14**
22 : For **WRV22**
28 : For **WRV28**

- **Sensor rail**

S-WRV [ ]

Equivalent bore size × **stroke**
(Sensor rail 1pc., bolt 2pcs.)

- **Magnet set**

MG-WRV [ ]

Equivalent bore size
14 : For **WRVM14**
22 : For **WRVM22**
28 : For **WRVM28**
(Sensor magnet 1pc., magnet holder 1pc., bolt 2pcs.)

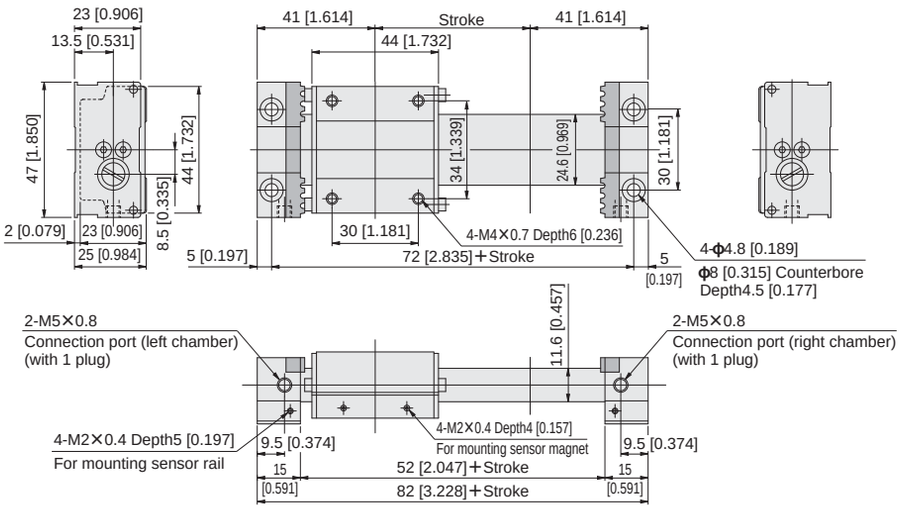
- **Shock absorber**

KSHJM [ ]

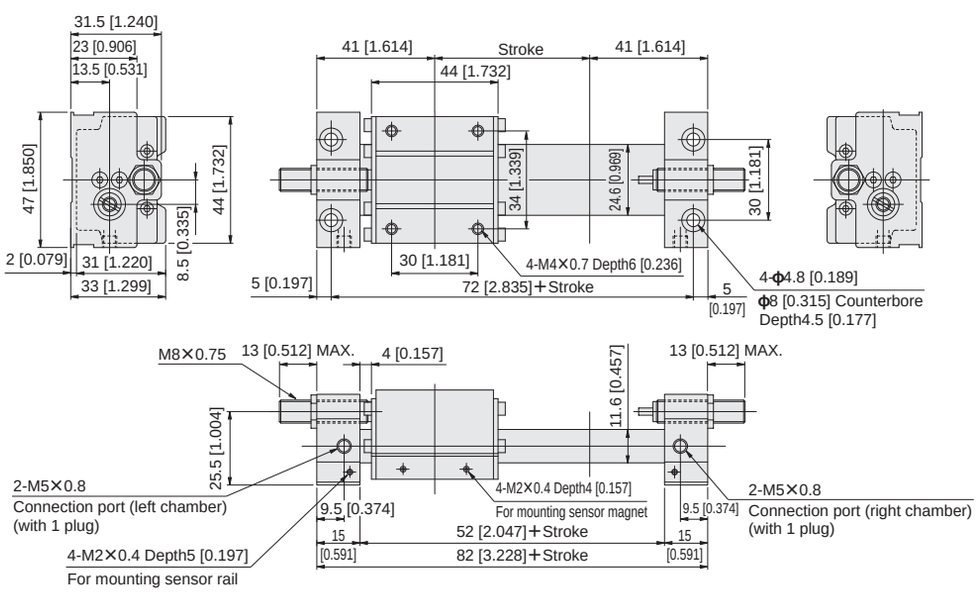
Size
8×5-14 : For **WRVP14CVA**
8×5-22 : For **WRVP22CVA**
10×10-28 : For **WRVP28CVA**

Dimensions of WRV*14 mm [in.]

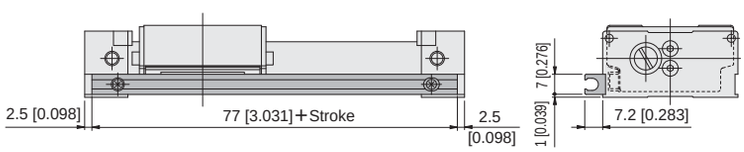
- **Basic type WRVP14CVK Stroke**



- **With shock absorber specification WRVP14CVA Stroke**

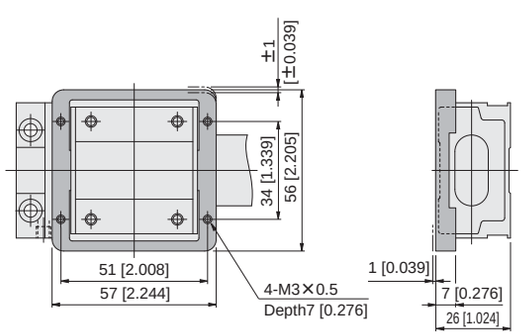


- **With sensor rail WRVM14CVK Stroke**



The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

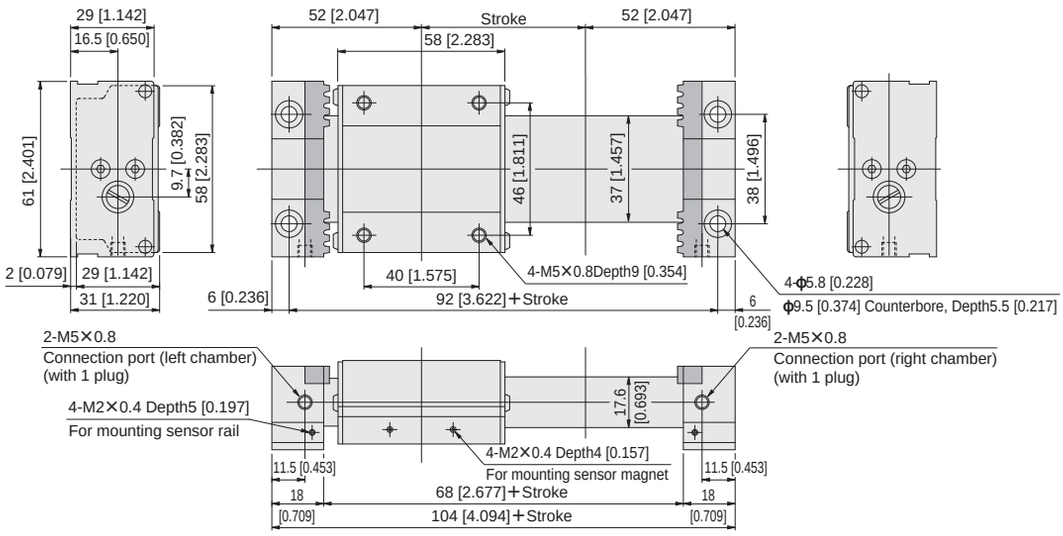
- **M-type mount**



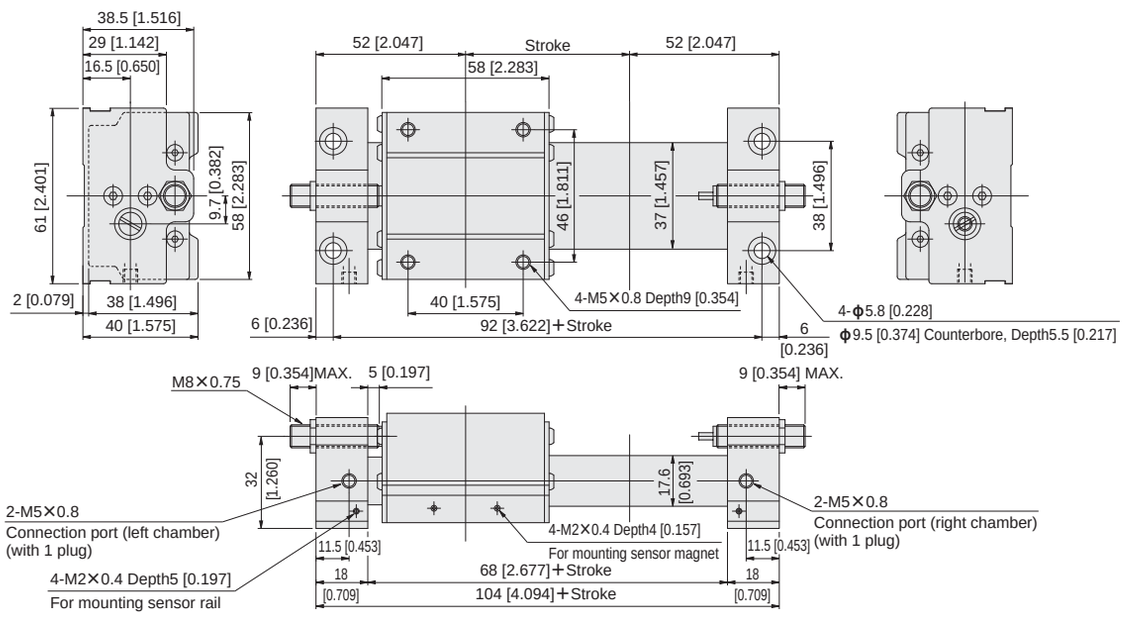
Note: When using an M-type mount, be sure to remove the plate bumper.

Dimensions of WRV*22 mm [in.]

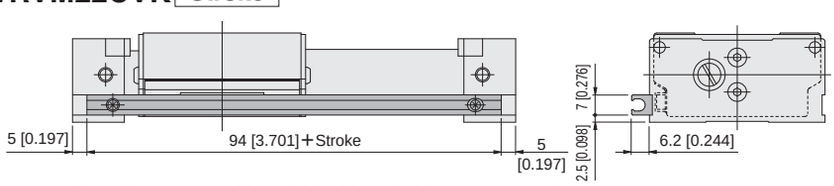
- **Basic type WRVP22CVK Stroke**



- **With shock absorber specification WRVP22CVA Stroke**

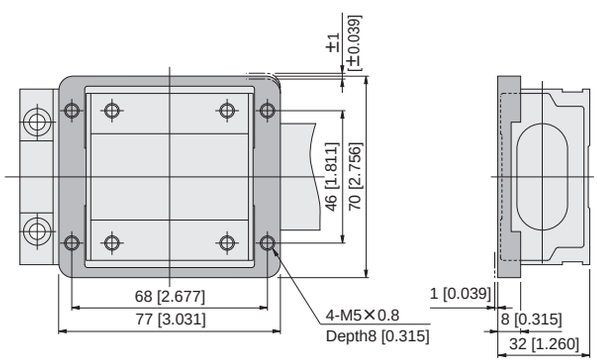


- **With sensor rail WRVM22CVK Stroke**



The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

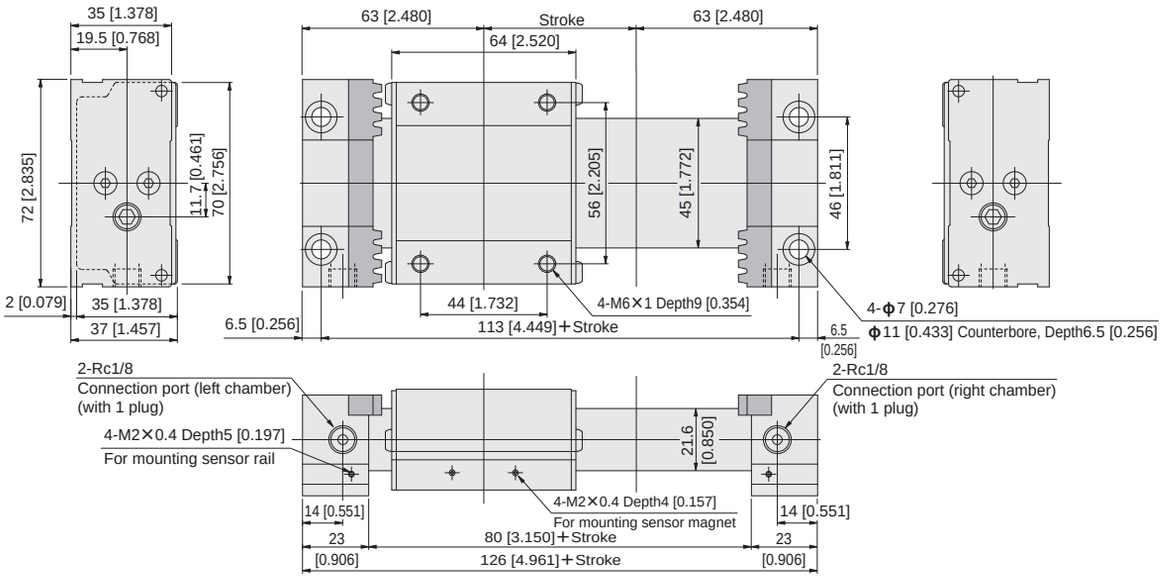
- **M-type mount**



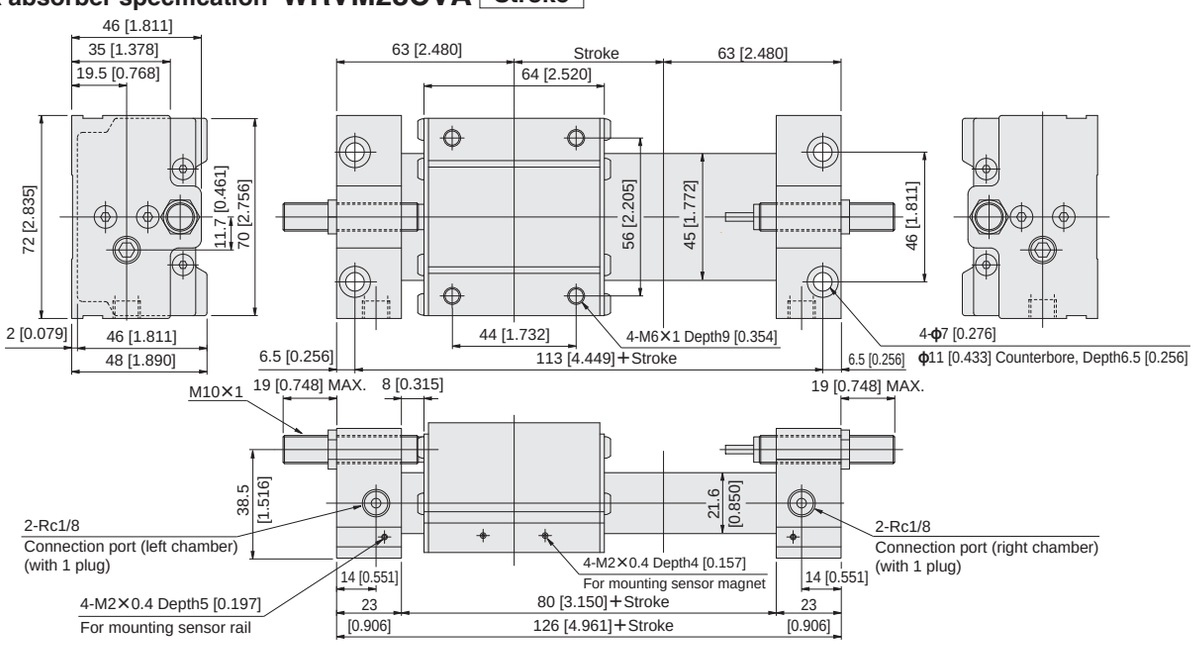
Note: When using an M-type mount, be sure to remove the plate bumper.

Dimensions of WRV*28 mm [in.]

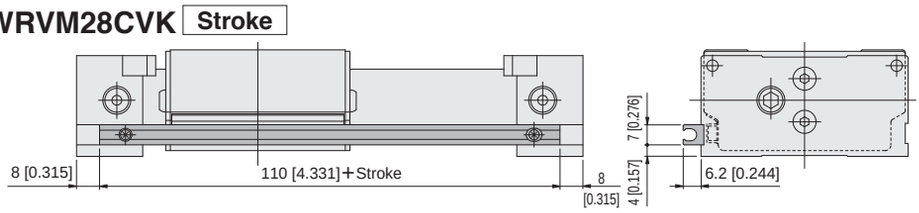
- **Basic type WRVP28CVK** **Stroke**



- **With shock absorber specification WRVM28CVA** **Stroke**

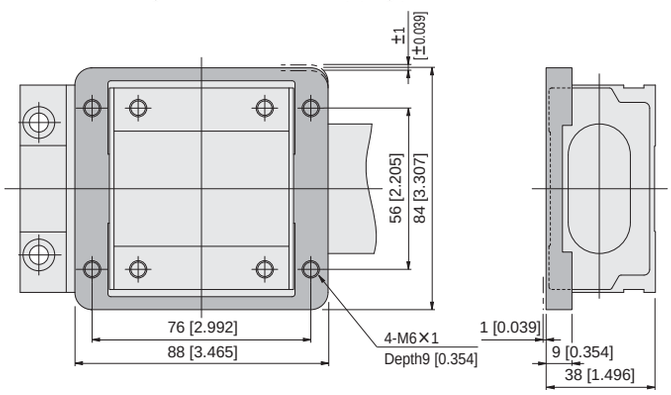


- **With sensor rail WRVM28CVK** **Stroke**



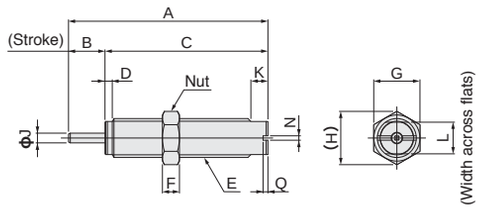
The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

- **M-type mount**



Note: When using an M-type mount, be sure to remove the plate bum

Dimensions of Shock Absorber mm [in.]



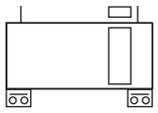
mm [in.]

Model	A	B	C	D	E	F	G	H	J	K	L	N	Q
KSHJM8X5-14 (for **WRVP14CVA**)	37 [1.457]	5 [0.197]	32 [1.260]	1.2 [0.047]	M8×7.5	2 [0.079]	10 [0.394]	11.5 [0.453]	2.5 [0.098]	3 [0.118]	7 [0.276]	1.3 [0.051]	1.5 [0.059]
KSHJM8X5-22 (for **WRVP22CVA**)													
KSHJM10X10-28 (for **WRVP28CVA**)	60 [2.362]	10 [0.394]	50 [1.969]	2 [0.079]	M10×1	3 [0.118]	12 [0.472]	13.9 [0.547]	3 [0.118]	5 [0.197]	8.5 [0.335]	1.3 [0.051]	1.5 [0.059]

SENSOR SWITCHES

Solid State Type, Reed Switch Type

Symbol



Specifications

• Solid State Type

Item \ Model	XEZE1D / XEZE1L	XEZ31D / XEZ31L
Wiring type	2-lead wire	3-lead wire
Lead wire direction	Horizontal (D) - Bent 90° (L)	
Voltage	- -	DC4.5~28V
Load voltage	DC10~28V	DC4.5~28V
Load current	4 ~20mA at 25°C [77°F], and 10mA at 60°C [140°F].	50mA MAX.
Consumption current	- -	10mA MAX. (DC24V)
Internal voltage drop Note 1	4.5V MAX.	0.5V MAX. (10V or less at 20mA)
Leakage current	1mA MAX. (DC24V, 25°C [77°F])	50μA MAX. (DC24V)
Response time	1ms MAX.	
Insulation resistance	100MΩ MIN. (At DC500V Megger, between case and lead wire terminal)	
Dielectric strength	AC500V (50/60Hz) in 1 minute (Between case and lead wire terminal)	
Shock resistance Note 2	294.2m/s^2 {30.0G} (Non-repeated shock)	
Vibration resistance Note 2	Total amplitude 1.5mm [0.06in.], 10 ~55Hz {88.3m/s^2 (9.0G)}	
Environmental protection	IEC IP67, JIS C0920 (Water-proof type)	
Operating indicator	When ON: Red LED indicator lights up	
Lead wire	PCCV 0.2SQ×2-lead (Brown and blue) ×R Note3	PCCV0.15SQ×3-lead (Brown, blue, and black)×R Note3
Ambient temperature	0° ~60°C [32° ~140°F]	
Storage temperature range	-10° ~70°C [14° ~158°F]	
Mass	35g [1.23oz.] (For lead wire length B: 3000mm [118in.])	

Notes: 1. The internal voltage drop depends on load current.
2. Measured by Automax test standard.
3. Lead wire length R : 3000m [118in.] ; M8 connector: 300mm.

• Reed Switch Type

Item \ Model	XRZE0D / XRZE0L		XRZE1D / XRZE1L	
Wiring type	2-lead wire			
Lead wire direction	Horizontal (D) - Bent 90° (L)			
Load voltage	DC5~28V	AC85~115V（r.m.s）	DC10~28V	AC85~115V（r.m.s）
Load current	40mA MAX.	20mA MAX.	5~40mA	5~20mA
Internal voltage drop Note 1	0.1V MAX. (At 40mA load current)		3.0V MAX.	
Leakage current	0mA			
Response time	1ms MAX.			
Insulation resistance	100MΩ MIN. (At DC500V Megger, between case and lead wire terminal)			
Dielectric strength	AC1500V (50/60Hz) in 1 minute (Between case and lead wire terminal)			
Shock resistance Note 2	294m/s^2 {30.0G} (Non-repeated shock)			
Vibration resistance Note 2	Total amplitude 1.5mm [0.06in.], 10 ~55Hz {88.3m/s^2 (9.0G)}, Resonance frequency 2750±250Hz			
Environmental protection	IEC IP67, JIS C0920 (Water-proof type)			
Operating indicator	None		When ON: Red LED indicator lights up	
Lead wire	PCCV0.2SQ×2-lead (Brown and blue)×R Note3			
Ambient temperature	0° ~60°C [32° ~140°F]			
Storage temperature range	-10° ~70°C [14° ~158°F]			
Contact protection	Required (See Contact Protection on p.)			
Mass	35g [1.23oz.] (For lead wire length 3000mm [118in.])			

Notes: 1. The internal voltage drop depends on load current.
2. Measured by Automax test standard.
3. Lead wire length R : 3000mm [118in.] ; M8 connector: 300mm.

Order Codes

• Sensor switch specification

Note: *To order separately*

XEZE1 | D | - | M8

Lead wire termination
Blank : Without connector (length wire: 3000mm [118in.])
M8: With M8 connector (length wire: 300mm [11.8in.])

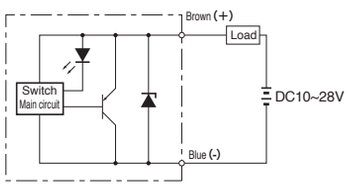
Lead wire orientation
D : Right output
L : Bent output (with angle 90°)

Sensor switch type
XEZE1D: 2-lead wire solid state type with indicator lamp DC10~28V
XEZE1L: 2-lead wire bent output solid state type with indicator lamp DC10~28V
XEZ31D: 3-lead wire solid state type with indicator lamp DC4.5~28V
XEZ31L: 3-lead wire bent outputsolid state type with indicator lamp DC4.5~28V
XRZE0D: 2-lead wire reed switch type without indicator lamp DC5~28V, AC85~115V
XRZE0L: 2-lead wire bent output reed switch type without indicator lamp DC5~28V, AC85~115V
XRZE1D: 2-lead wire reed switch type with indicator lamp DC10~28V, AC85~115V
XRZE1L: 2-lead wire bent output reed switch type with indicator lamp DC10~28V, AC85~115V

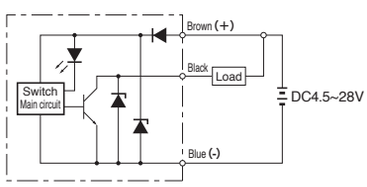
Internal Circuit Diagrams

• Solid state type

• 2-lead wire type **(XEZE1D)**

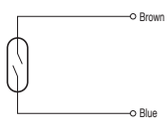


• 3-lead wire type **(XEZ31D)**

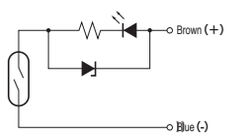


• Reed switch type

• Without indicator lamp **(XRZE0D)**



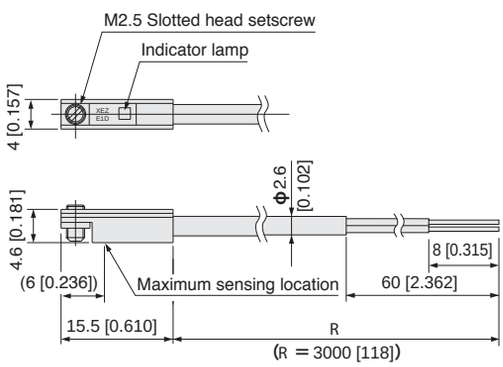
• With indicator lamp **(XRZE1D)**



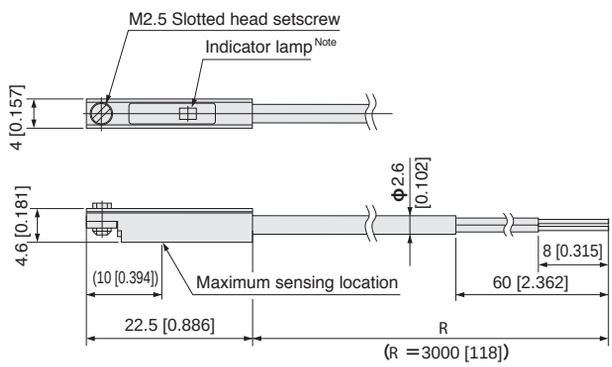
Dimensions of Sensor Switch mm [in.]

• Horizontal Lead Wire

• **Solid state type (XEZE1D, XEZ31D)**



• **Reed switch type (XRZE0D, XRZE1D)**

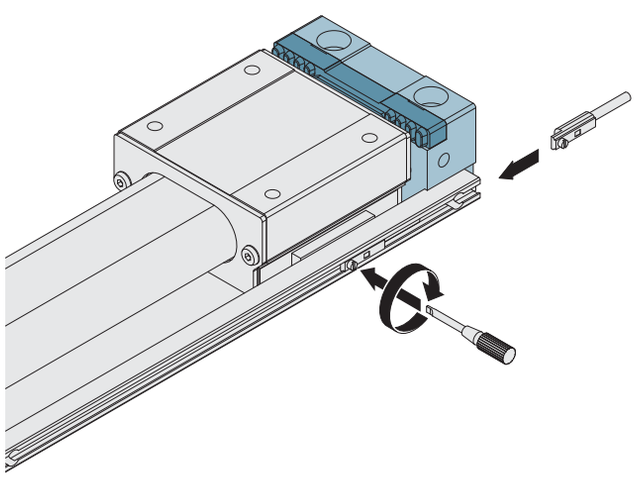


Note: Not available with **XRZE0D**

Moving Sensor Switch

Loosening the mounting screw allows the sensor switch to be moved along the switch mounting groove on the barrel.

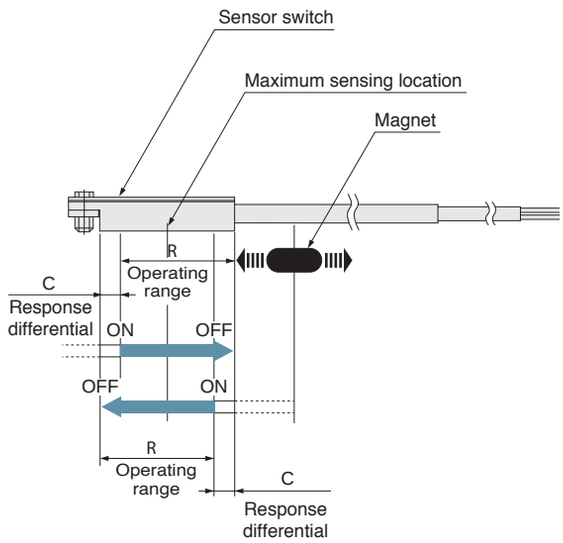
● Tighten the mounting screw with tightening torque of 0.1N•m? 0.2N•m {1kgf•cm? 2kgf•cm} [0.9in·lbf? 1.8in·lbf].



Sensor Switch Operating Range, Response Differential, and Maximum Sensing Location

● Operating range :R
The distance the piston travels in one direction, while the switch is in the ON position.

● Response differential : C
The distance between the point where the piston turns the switch ON and the point where the switch is turned OFF as the piston travels in the opposite direction.



●Reed switch type

mm [in.]

Model	WRVM14	WRVM22	WRVM28
Operating range : r	7 ~8.6 [0.276 ~0.339]	7.5 ~8.6 [0.295 ~0.339]	6.8 ~8.5 [0.268 ~0.335]
Response differential : C	1.2 [0.047] or less	1.2 [0.047] or less	1 [0.039] or less
Maximum sensing location※	10 [0.394]		

Remark: The values in the above table are reference values.
※ : It is a value measured from the other end side of the lead wire.

●Solid state type

mm [in.]

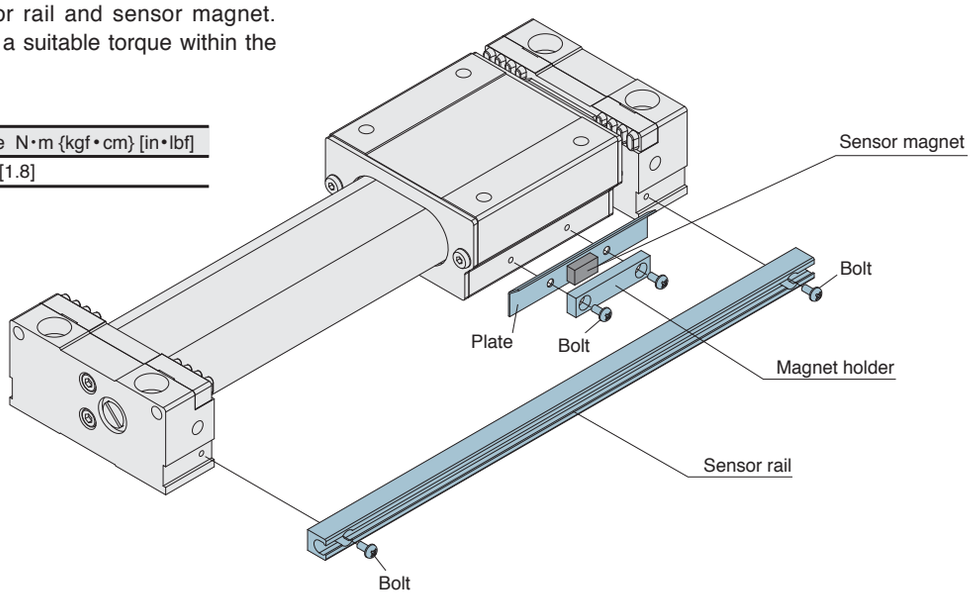
Model	WRVM14	WRVM22	WRVM28
Operating range : r	2.6 ~3.5 [0.102 ~0.138]	2.8 ~3.7 [0.110 ~0.146]	2.6 ~4.0 [0.102 ~0.157]
Response differential : C	0.9 [0.035] or less	1.1 [0.043] or less	1.2 [0.047] or less
Maximum sensing location※	6 [0.236]		

Remark: The values in the above table are reference values.
※ : It is a value measured from the other end side of the lead wire.

Mounting the Sensor Rail and Sensor Magnet

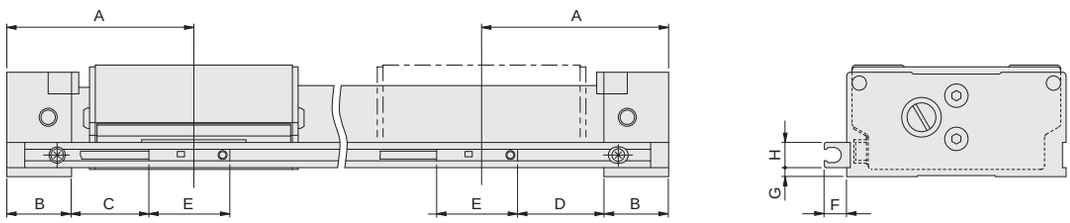
The Flat Rodless cylinder has tapped holes on the cylinder's both sides for mounting the sensor rail and sensor magnet. When securing the bolts, tighten to a suitable torque within the allowed range limits.

Bolt	Maximum tightening torque N•m {kgf•cm} [in•lbf]
M2×0.4	0.2 {2} [1.8]



Mounting Location of End of Stroke Detection Sensor Switch

When the sensor switch is mounted in the locations shown below, the magnet comes to the maximum sensing location of the sensor switch at the end of the stroke.



●Reed switch-type **(XRZE0D, XRZE1D)**

mm [in.]

Model	A	B	C	D	E	F	G	H
WRVM14	41 [1.614]	15 [0.591]	13.5 [0.531]	16 [0.630]	22.5 [0.886]	7.2 [0.283]	1 [0.039]	7 [0.276]
WRVM22	52 [2.047]	18 [0.709]	21.5 [0.846]	24 [0.945]		6.2 [0.244]	2.5 [0.098]	
WRVM28	63 [2.480]	23 [0.906]	27.5 [1.083]	30 [1.181]			4 [0.157]	

●Solid state-type **(XEZE1D, XEZ31D)**

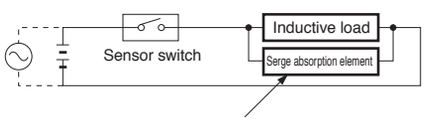
mm [in.]

Model	A	B	C	D	E	F	G	H
WRVM14	41 [1.614]	15 [0.591]	16.5 [0.650]	20 [0.787]	15.5 [0.610]	7.2 [0.283]	1 [0.039]	7 [0.276]
WRVM22	52 [2.047]	18 [0.709]	24.5 [0.965]	28 [1.102]		6.2 [0.244]	2.5 [0.098]	
WRVM28	63 [2.480]	23 [0.906]	30.5 [1.201]	34 [1.339]			4 [0.157]	

Contact Protection for Reed Switch Type Sensor Switches

In order to use the reed switch type sensor switches in a stable condition, take the following contact protection measures.

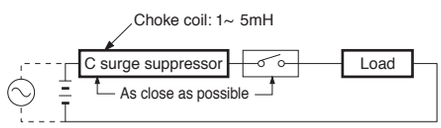
- **When connecting inductive load (electromagnetic relay, etc.).**



For DC··· Diode, CR, etc.
For AC··· CR, etc.
Diode: Forward current should be more than the circuit current.
Reverse voltage should withstand inverse voltage that is 10 times or more of the circuit voltage.
C: 0.01~ 0.1μF
R: 1~ 4kΩ

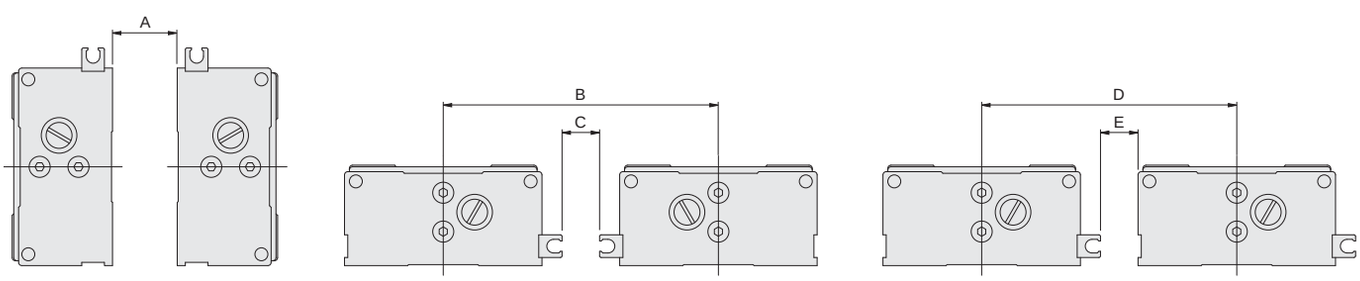
- **When capacity serge is generated.**

(When lead wire length exceeds 10m.)



When Mounting the Cylinders with Sensor Switches in Close Proximity

When mounting Flat Rodless cylinders in close proximity, use them at the values shown in the table below, or larger.



●Reed switch type

mm [in.]

Model	A	B	C	D	E
WRVM14	0	59.4 [2.339]	0	53.2 [2.094]	0
WRVM22	0	73.4 [2.890]	0	67.2 [2.646]	0
WRVM28	0	84.4 [3.323]	0	78.2 [3.079]	0

●Solid state type

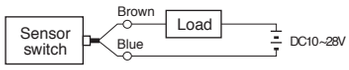
mm [in.]

Model	A	B	C	D	E
WRVM14	3 [0.118]	61.4 [2.417]	2 [0.079]	55.2 [2.173]	2 [0.079]
WRVM22	0	76.4 [3.008]	3 [0.118]	69.2 [2.724]	2 [0.079]
WRVM28	0	87.4 [3.441]	3 [0.118]	84.2 [3.315]	6 [0.236]

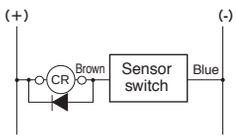
Points of Wiring Solid State Type Sensor Switches

2-lead wire type

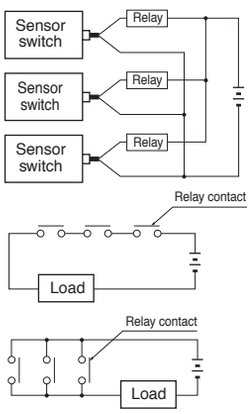
Basic connection



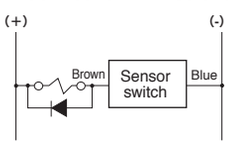
Connection with relays



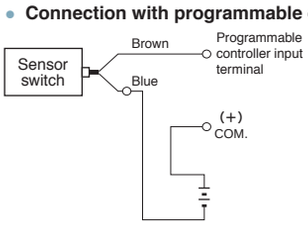
AND (series) connection and OR (parallel) connection



Connection with solenoid valve

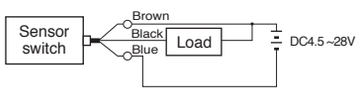


Connection with programmable controller

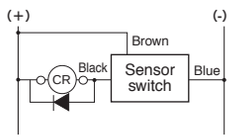


3-lead wire type

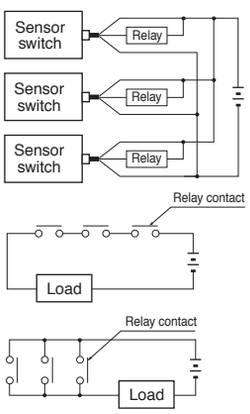
Basic connection



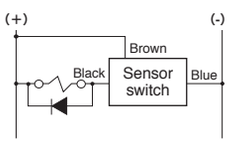
Connection with relays



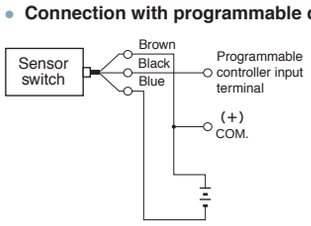
AND (series) connection and OR (parallel) connection



Connection with solenoid valve

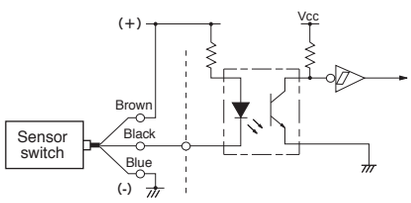


Connection with programmable controller

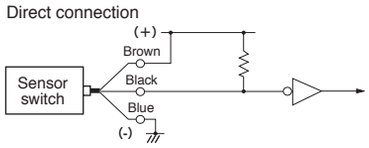


Connection with TTL

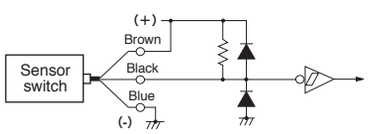
Separate connection



Direct connection



Connection to C-MOS



Cautions:

1. Connect wires according to the color of the lead wires. If the connection is incorrect, it could cause damage to the sensor switch due to the absence of a surge suppression protection.
2. Do not connect the 2-lead wire solid state type sensor switch to TTL or C-MOS.
3. A surge suppression protection diode is recommended for the inductive load of electromagnetic relays, etc.
4. Avoid series (AND) connection because the voltage of the circuit will drop in proportion to the number of sensor switches.
5. When using parallel (OR) connection, the same sensor output lines (e.g. the same black lead wires) can be connected together, but the current leakage will increase by the number of sensor switches. Therefore, be aware of load return abnormalities.
6. Because the sensor switches are a magnetically sensitive type, avoid using them in locations subject to strong external magnetic fields or bringing them too close to power lines or to where other large electric currents are present. In addition, do not use magnetic material for the mounting bracket, because it will cause erratic operations.
7. Do not pull or bend the lead wires excessively.
8. Avoid using sensor switches in strong chemical or gas environments.
9. Consult us for use in ambient atmospheres subject to water or oil.